State Water Resources Control Board
Division of Water Quality
GAMA Program

GROUNDWATER INFORMATION SHEET

1,2,3-Trichloropropane (TCP)

Revised: November 17, 2009

The purpose of this groundwater information sheet is to provide general information regarding a specific constituent of concern (COC). The following information, compiled by staff of the Groundwater Ambient Monitoring and Assessment (GAMA) Program, is pulled from a variety of sources and data relates mainly to drinking water. For additional information, the reader is encouraged to consult the references cited at the end of the information sheet.

GENERAL INFORMATION	
Constituent of Concern	1,2,3-Trichloropropane (TCP)
Aliases	Allyl trichloride, glycerol trychlorohydrin, trichlorohydrin
Chemical Formula	$C_3H_5Cl_3$
CAS No.	96-18-4
Storet No.	77443
Summary	The California Department of Public Health (CDPH) identifies 1,2,3 Trichloropropane (TCP) as an unregulated chemical (no Maximum Contaminant Level (MCL) requiring monitoring. The CDPH notification level for TCP is 0.005 μg/L. Common sources of TCP include discharges related to solvent use. Based on CDPH data through 2008, 272 of approximately 8,720 public drinking water wells (active and standby status) have had concentrations of TCP > 0.005 μg/L. Most detections have occurred in Kern, Fresno, and Los Angeles Counties, however, several wells in Merced County have the highest TCP concentrations in the state (between 50 and 150 μg/L).

REGULATORY AND WATER QUALITY LEVELS[1]		
Type	**Agency**	**Concentration**
Federal MCL	US EPA, Region 9	N/A
State MCL	CDPH	N/A
Notification Level	CDPH	0.005 μg/L
Detection Limit for Purposes of Reporting (DLR)	CDPH	0.005 μg/L
CA Public Health Goal	OEHHA	0.0007 μg/L
Others: Screening Level –Tap Water ($1/10^6$ cancer risk) Soil Screening for Groundwater Protection IRIS Reference Dose (non-cancer health effects)	US EPA, Region 9	0.0096 μg/L 0.0044 μg/kg 42.0 μg/L

[1]These levels generally relate to drinking water, other water quality levels may exist. For further information, see A Compilation of Water Quality Goals (Marshack, 2008).
MCL = Maximum Contaminant Level
US EPA = United States Environmental Protection Agency
OEHHA = Office of Environmental Health and Human Hazard Assessment
IRIS = Integrated Risk Information System

SUMMARY OF DETECTIONS IN PUBLIC DRINKING WATER WELLS[2]	
Detection Type	**Number of CDPH regulated Wells**
Number of active and standby public drinking water wells[3] with TCP concentration > 0.005 μg/L.	272 of 8,723 Active and Standby wells
Top 3 counties having public drinking water wells with TCP concentration > 0.005 μg/L.	Kern (95), Fresno (29), Los Angeles (24)

[2]Based on CDPH data collected from 1995-2008 (GeoTracker GAMA). Drinking water supplied from active and standby public water wells is typically treated and/or blended. Individual wells and wells for small water systems not regulated by CDPH are not included.

ANALYTICAL INFORMATION		
Method	**Detection Limit (Quantitation Limit)**	**Note**
US EPA 504.1, 551.1	0.02 – 0.08 μg/L (0.1 μg/L)	CDPH approved for public drinking water systems
US EPA 524.2	0.03 μg/L (0.5 μg/L)	CDPH approved for public drinking water systems
US EPA 8260B	0.09 – 0.32 μg/L (1 – 5 μg/L)	Site Assessment
LLE-GC/MS and PT-GC/MS	0.005 μg/L	Developed by CDPH
Known Limitations to Analytical Methods	US EPA methods 8010, 8021, or 8260 (approved for TCP analysis) have quantitation limits of 10, 5 and 1 to 5 μg/L, respectively. These are above the DLR. Two methods; LLE-GC/MS (Liquid-Liquid Extraction and Gas Chromatography) and PT-GC/MS (Purge and Trap Gas Chromatography), are able to measure TCP at the DLR. They were developed by CDPH, but are expensive and require well-experienced laboratory analysts.	
Public Drinking Water Testing Requirements	TCP is an unregulated organic chemical in public water systems requiring monitoring and reporting to CDPH. A CDPH Action Level, presently Notification Level of 0.005 μg/L was established in 1999. Analytical methods to meet the notification level were established in 2002. Based on detections of TCP in California groundwater, CDPH/OEHHA decided to establish a Public Health Goal (PHG) at 0.0007μg/L in 2009, and will subsequently establish an MCL for TCP in the future.	

TCP OCCURRENCE	
Anthropogenic Sources	In the past, TCP has been used mainly as a solvent and an extracting agent (paint and varnish remover, cleaning and degreasing agent, and cleaning and maintenance solvent). Currently, TCP is used as a chemical intermediate in the production of polysulfone liquid polymers and dichloropropene, synthesis of hexafluoropropylene, and as a cross-linking agent in the synthesis of polysulfides. TCP has been formulated with dichloropropenes in the manufacturing of a soil fumigant

	nematocide D-D, which is no longer available in the United States.
Natural Sources	TCP is a manufactured chemical and does not occur naturally in the environment.
History of Occurrence	TCP was found in extracts of treated groundwater associated with hazardous waste cleanup at a southern California Superfund site in the late 1990's. This prompted the CDPH to establish an Action Level (now Notification Level) of 0.005 μg/L in 1999. Since then, TCP has been found in 272 groundwater samples at concentrations ranging from 0.006 to 150 μg/L. The highest concentrations of TCP were measured in Merced County at 150 μg/L. In Kern, Fresno and LA counties, concentrations of TCP have ranged from 0.006 to over 50 μg/L. TCP was found in groundwater at 4.71% of the CDPH groundwater sources according to the State Water Resources Control Board's (SWRCB's) GeoTracker GAMA database. In 1974, TCP was also qualitatively detected in effluent from an advanced waste treatment plant in Lake Tahoe.
Contaminant Transport Characteristics	TCP is slightly soluble in water, with a reported solubility range from 1,900 mg/L to 2,700 mg/L. Reportedly, TCP has a very low soil sorption coefficient. The U.S. EPA published a K_{oc} value of 51. TCP is not readily degraded in most groundwater, and would be readily transported within an aquifer following the hydraulic gradient. Because it's density (1.4) is heavier than water, pure-phase liquid TCP will sink into deeper parts of an aquifer in the form of a dense non-aqueous phase liquid (DNAPL).

REMEDIATION & TREATMENT TECHNOLOGIES	
Groundwater Remediation	TCP can be removed using traditional methods applied for other chlorinated hydrocarbons, such as pump and treat, in-situ oxidation, permeable reactive barriers, dechlorination by hydrogen releasing compound, and emerging biodegradation techniques. The cleanup method will depend on TCP concentration in groundwater or soil; extend of the contaminated zone, specific physico-chemical and biological conditions of soil and groundwater. <u>Natural Attenuation</u> There were no data found on natural attenuation of TCP, but it may occur under favorable conditions. The half-life of TCP, based on acclimated aerobic soil grab samples, was from six months to one year. However, these values may differ from those in groundwater (one to two years). At most contaminated sites, solvents last much longer than would be expected if this half-life was an accurate estimate of in-situ behavior.
Drinking Water and Wastewater Treatment	Above ground treatment consists of air stripping with activated carbon filtration, as used for other chlorinated hydrocarbons. UV radiation can also be used for a low-flow system. Wastewater treatment plants use chemical oxidizers like potassium permanganate, and increasingly biodegradation processes to remove chlorinated hydrocarbons from water. The abovementioned treatment methods are costly and can be a economic challenge to remove and analyze TCP below its notification level.

HEALTH EFFECT INFORMATION
Acute Health effects: Contact with TCP can irritate and burn the skin and eyes. Breathing TCP can irritate the nose, throat and lungs, cause headache, affect concentration, memory and muscle coordination. *Chronic* Health Effects: there are no data on chronic health effects associated with TCP. *Cancer* Hazard: TCP has been shown to cause cancer in animals, and is recognized by the State of California as a human carcinogen, for purposes of the Safe Drinking Water and Toxic Enforcement Act of 1986 (“Proposition 65”). TCP was added to the list of carcinogens in 1992. The CDPH notification level and PHG for drinking water are based on potential cancer risk.

KEY REFERENCES

1. Agency for Toxic Substance Control and Disease Registry (ATSDR), *ToxFAQs for 1,2,3-Trichloropropane*. http://www.atsdr.cdc.gov/tfacts.html (Sept. 2002)

2. Book S., California Department of Health Services, Personal Communication, April 2002.

3. California Department of Public Health. *Drinking Water Systems: Chemicals and Contaminants in Drinking Water.* http://www.cdph.ca.gov/certlic/drinkingwater/Pages/123TCP.aspx

4. California Department of Health Services. Determination of 1,2,3-Trichloropropane in Drinking Water by Continuous Liquid-Liquid Extraction and Gas Chromatography/Mass Spectrometry. Berkeley, California. February 2002.

5. California Environmental Protection Agency / Regional Water Quality Control Board, Central Valley Region. July 2008. *A Compilation of Water Quality Goals*. Prepared by Jon B. Marshack. http://www.waterboards.ca.gov/centralvalley/water_issues/water_quality_standards_limits/water_quality_goals/wq_goals_2008.pdf

6. Howard, P. H. Handbook of Environmental Degradation Rates. CRC Press LLC. 1991.

7. Montgomery, J.H. Groundwater Chemicals Desk Reference. 3rd Edition, Lewis Publishers, 2000

8. U.S. Environmental Protection Agency. Drinking Water Standards and Health Advisories. EPA 822-B-00-001. Summer 2000.

9. U.S. Environmental Protection Agency, Region 9. Preliminary Remediation Goals-Screening levels for Chemicals Contaminants. http://www.epa.gov/region09/superfund/prg/index.html

10. U.S. Environmental Protection Agency- Emerging Contaminant-1,2,3-Trichloropropane. http://www.epa.gov/tio/download/contaminantfocus/epa542f07008.pdf

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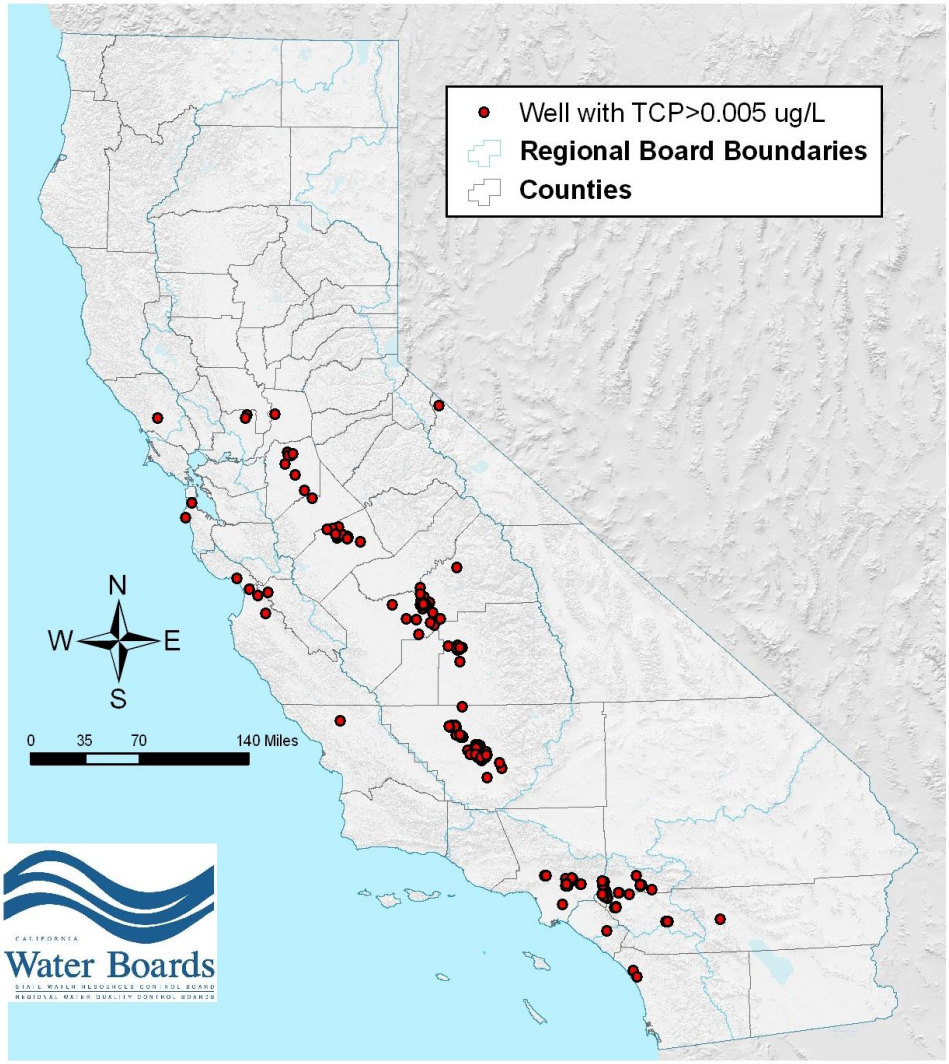
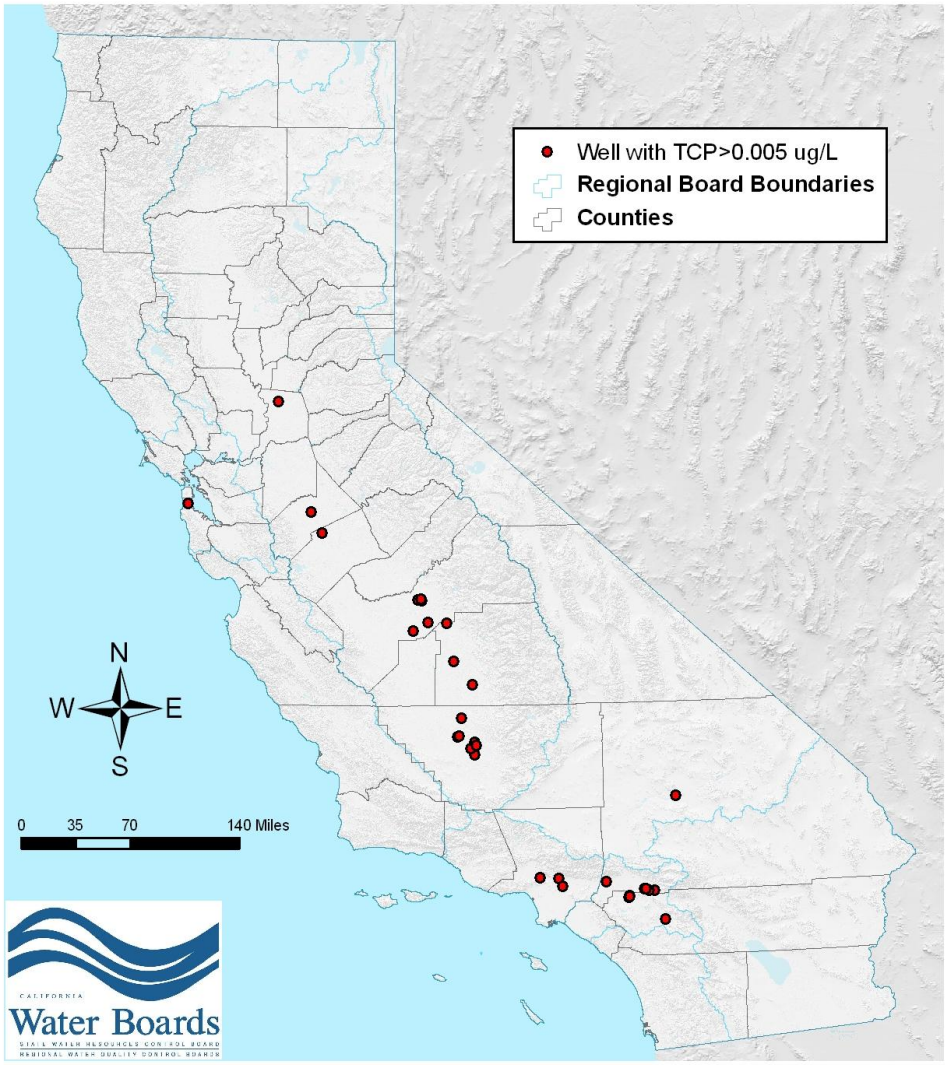


Active and Standby CDPH Wells with at Least One Detection of 1,2,3-Trichloropropane (TCP) >0.005 ug/L, Notification Level (272 wells)

Source: 1995-2008 CDPH Data (Rev. 11/17/09 by J. Stepek)

GEOTRACKER-GAMA



Abandoned, Destroyed and Inactive CDPH Wells with at Least One Detection of 1,2,3-Trichloropropane (TCP) >0.005 ug/L, Notification Level (32 wells)

Source: 1995-2008 CDPH Data (Rev. 11/17/09 by J. Stepek)

GEOTRACKER-GAMA